

News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Administration Building, A635, Gaithersburg, MD 20899; telephone: 301/975-3572.

NEW WAYS NEEDED TO TEST FIRE SAFETY OF WIRING

Most electrical wire and cable tests tell little or nothing about their performance during a fire or whether they would pose a danger to building occupants, NIST researchers say. To get a better picture, the researchers recommend using techniques that measure physical properties (such as the rate at which a material releases heat and the amount of smoke and toxic gas produced) in conjunction with computer modeling. In the first phase of a study for the National Electrical Manufacturers Association, more than 100 standard tests and laboratory studies used in the United States and abroad were examined. In the next phase, physical property measurements will be used with NIST's HAZARD I computer model to evaluate wire and cable products. A report, *Fire Performance of Wire and Cable: Reaction-to-Fire Tests—A Critical Review of the Existing Methods and of New Concepts* (NIST Technical Note 1291), is available for \$26 prepaid from the National Technical Information Service, Springfield, VA 22161. Order by PB 92-141563.

NEW "FREEWARE" COMPUTES SIGNAL FREQUENCIES

Chemists, physicists, and astronomers have long used complex mathematical equations to make sense of their observations. When their observations fall into random, fluctuating patterns—like

ocean waves or temperature changes—a mathematical operation called the Fourier transform is especially helpful. This type of analysis breaks the patterns into sine waves with varying frequencies, amplitudes, and phases. The Fourier transform, named for the French mathematician who invented it in 1807, enables scientists to determine the amplitude and phase at each sine wave frequency. Commercially available software can perform Fourier transforms rapidly, but details cannot be changed by the user. However, a NIST engineer is distributing his own program as freeware to enable the user to better understand the details of the transform and its accuracy. Spectrum V 1.0 is available with a manual and source code so the user can modify it as desired. It is written in FORTRAN for IBM-PC or compatible computers. To request a copy of Spectrum, contact David E. Hess, Rm. 105, Fluid Mechanics Building, NIST, Gaithersburg, MD 20899, 301/975-5937, fax: 301/258-9201, Email: Hess@ENH.NIST.GOV.

REPORT OFFERS GUIDELINES ON FTAM IMPLICATIONS

The Government Open Systems Interconnection Profile, Federal Information Processing Standard 146-1, specifies that federal agencies acquiring File Transfer, Access, and Management (FTAM) systems procure products that conform to international standard ISO 8571. But which FTAM implementation will best suit a user's function and performance requirements? NIST offers help in a new report produced by agency scientists. The document compares procurement of FTAM products to buying a new car. Using this analogy, the authors walk the reader through each step of the FTAM evaluation process. The report contains a tutorial on FTAM and a detailed section describing many functions potentially available in FTAM implementations (override or access

passwords, for example). Also included is an extensive appendix containing suggested FTAM experiments, a glossary, and abbreviations. Guidelines for the Evaluation of File Transfer, Access, and Management Implication (NIST Special Publication 500-196), is available for \$19 (print) or \$9 (microfiche) prepaid from the National Technical Information Service, Springfield, VA 22161. Order by PB 92-126580/AS.

DO IRREGULAR PIPES AFFECT FLOW MEASUREMENTS?

Small inaccuracies in meter measurements can translate into million-dollar-a-day losses in the custody transfer of fuels and other valuable chemical fluid products. Ideally, flow meters are installed on long, straight pipes for the most accurate readings. But pipes, whether for water, natural gas, or chemical products, do not always follow ideal configurations. As part of a consortium with flow meter manufacturers and flow meter users, NIST researchers are assessing how placing flow meters near elbows, tees, and other bends affects their performance. Two new reports that document this research are available. The first is Tube Bundle Effects (NISTIR 4751), available from the National Technical Information Service, Springfield, VA 22161 for \$17 (print) or \$9 (microfiche) prepaid. Order by PB 92-149855. The second publication, TEE Used As An Elbow Configuration (NISTIR 4753), is available from NTIS for \$19 (print) or \$9 (microfiche) prepaid. Order by PB 92-149848.

INSULATION PROGRAM COVERS ENTIRE BUILDING ENVELOPE

The NIST National Voluntary Laboratory Accreditation Program (NVLAP) for thermal insulation materials (TIM) has been expanded to cover the integrity of the entire building envelope. The new thermal insulation and building envelope materials program (TIB) now includes test methods for thermal insulation, windows, doors, seals and sealants, and other materials that contribute to the energy performance of a building. Eleven test methods were added to the TIM program at the request of an independent testing laboratory accredited by NVLAP. Other appropriate fields and test methods for building envelope materials may be added to the program under NVLAP procedures. For information on the expanded TIB program, contact Lawrence S. Galowin, Rm. A124, Building 411, NIST, Gaithersburg, MD 20899, 301/975-4016, fax: 301/926-2884.

TWENTY-SEVEN GRANTS ANNOUNCED FOR ATP'S 2ND YEAR

Commerce Secretary Barbara Hackman Franklin on April 21 announced the second set of grants under the Commerce Department's Advanced Technology Program (ATP). The NIST-administered grants to private industry are designed to stimulate research and development of cutting-edge, generic technologies with significant commercial promise. Twenty-seven new programs were selected for funding under the ATP, including proposals in advanced materials, biotechnology, computing, electronics, and high-temperature superconductivity. The awards will provide approximately \$25 million in first-year grants to initiate nearly \$190 million in R&D programs over the next 5 years. More than half of the cost will be paid by sponsoring firms.

PROGRAM ANNOUNCED FOR PRECISION CASTING OF ALLOYS

A cooperative research and development program to improve the casting of metal alloys commonly used in the aerospace industry has been proposed by NIST in cooperation with the Aerospace Industries Association and the National Center for Advanced Technology. The goal is to plan and undertake research on precision casting so that the planning, research, and technology transfer can be coordinated and brought quickly to manufacturers. The consortium will be a cooperative, distributed effort by industry, universities, and other government agencies. Research will be carried out in-house by consortium members as well as by NIST. Companies should be prepared to invest adequate resources and be firmly committed to the goal of developing new casting technology. Participation in the program will require a \$10,000 annual contribution per year to cover administrative costs (not required by university participants) and in-kind research contributions to the consortium. For information, contact H. Thomas Yolken, Office of Intelligent Processing of Materials, B344 Materials Building, NIST, Gaithersburg, MD 20899, 301/975-5727.

3-D COMPUTER MODEL PREDICTS OIL FIRE "FOOTPRINTS"

A new simulation model developed by NIST fire researchers and mathematicians predicts in three dimensions the airborne concentration of smoke particles billowing off major oil fires. The model also calculates the unique smoke "footprint"—the distribution of smoke particles falling to the

ground—for fires of varying sizes and occurring under different wind conditions. The model is part of a larger project to find better ways to rapidly clean up large oil spills. One possible solution is to burn the spilled oil. With funding from the Minerals Management Service, the U.S. Coast Guard, and the American Petroleum Institute, NIST researchers are studying what happens during burning, what is left on the water after the oil has burned, and what goes into the air. This project aims to give local authorities the information on distribution of smoke and oil residue they need to decide if burning an oil spill would cause less environmental damage than other clean-up options.

WOOD PRODUCTS INDUSTRY DEFINES FEDERAL ROLE

Private-sector panelists from a NIST/industry workshop recently made several recommendations for an active federal role assisting in conformity assessment activities in order to gain acceptance of U.S. products in international markets such as the European Community (EC). Government, said the panel, should serve as a clearinghouse for information on conformity assessment requirements in the EC; establish a wood products sector advisory committee to assist the development of U.S. negotiating positions with the EC; take an active role in accrediting U.S. programs to satisfy EC directives; negotiate with the EC on the scope and authority of EC notified bodies to subcontract product testing and quality assessment to qualified U.S. testing and inspection agencies; and assist industry in developing a national accreditation program for testing and certification. The panel's report, *Conformity Assessment Workshop on Wood Products (NISTIR 4771)*, is available from the National Technical Information Service, Springfield, VA 22161 for \$19 prepaid. Order by PB 92-162544.

NINETY COMPANIES VIE FOR 1992 BALDRIGE AWARD

NIST has announced that 90 companies have applied for the 1992 Malcolm Baldrige National Quality Award. The number includes 31 manufacturing firms, 15 service companies, and 44 small businesses. Last year, 106 companies applied and three won. The award, named for the late Commerce Secretary Malcolm Baldrige, was established by legislation in August 1987. It promotes national awareness about the importance of improving quality management and recognizes quality achievements of U.S. companies—though the award is not for specific products or services. Firms applying must undergo a rigorous examina-

tion. On-site visits for those passing an initial screening will take place in September and will be followed by an announcement and award ceremony in the fall. In previous years, the awards have been presented by the president or vice-president during a ceremony in Washington, DC. The award program is managed by NIST with the active involvement of the private sector. A maximum of two awards may be given annually in each of three categories: manufacturing, service, and small business.

GUNPOWDER "FINGERPRINTS" COULD CATCH CROOKS QUICKER

Efforts to curb violent crime could soon get a boost from NIST scientists who, in collaboration with the National Institute of Justice, are developing a rapid, inexpensive way to prove whether or not a suspect has fired a weapon. The technique, known as micellar electrokinetic capillary electrophoresis (MECE), takes less than 1 h. Current forensic laboratory methods can take days, requiring expensive equipment and dust-free clean rooms. Instruments for MECE cost less and tests could be done in most major police labs, says a NIST chemist. To perform the test, a police officer would lift gunshot residue from a suspect's hands with masking tape. Investigators would then dissolve residue particles from the tape and pass them through a thin capillary. An electric field forces compounds in the particles to separate, resulting in a unique pattern, or "fingerprint."

TWO MIXTURES COULD REPLACE BANNED REFRIGERANT

NIST researchers say two refrigerant mixtures appear promising as environmentally safe replacements for R22, a refrigerant widely used in residential heat pumps. The Clean Air Act of 1990 calls for hydrochlorofluorocarbons (HCFCs), such as R22, to be phased out starting in 2015. HCFCs belong to a family of chemicals believed to be damaging to the Earth's atmosphere. The two mixtures, named R32/R134a and R32/R152a, do not contain chlorine or bromine, the two main catalysts some believe are destroying the Earth's ozone layer. The researchers used a NIST-developed computer simulation program, called CYCLE11, and a laboratory version of a heat pump to examine how the mixtures would perform in the machine. The NIST study showed that the two mixtures could perform up to 15 percent better than R22. NIST is currently conducting flammability testing to evaluate the one possible drawback, the fact that both mixtures contain at least one flammable component.

COMMENT PERIOD EXTENDED FOR PROPOSED CASE PROGRAM

NIST is extending the deadline for public comments on the proposed conformity assessment systems evaluation (CASE) program from May 26, 1992 to July 24, 1992. The voluntary program is intended as a mechanism to provide federal assurances to the Commission of the European Communities and other governments of the competency of qualified U.S. conformity assessment activities related to laboratory testing, product certification, and quality systems registration. Written remarks about the proposed CASE program must be submitted by July 24, 1992. Comments and requests for information should be sent to Stanley I. Warshaw, director, Office of Standards Services, A306 Administration Building, NIST, Gaithersburg, MD 20899, 301/975-4000, fax: 301/963-2371.

HOW FAST DOES A LEAK LEAK? ASK NIST

A tiny leak can be a huge problem for food packagers, pharmaceutical companies, and aerospace engineers. Minuscule holes in food wrappers or fuel sealers can result in illness, accidents, or even death. For this reason, manufacturers carefully test their packaging and products for the tiniest of leaks. The tests compare leakage from the product against a known leakage rate from a specially designed gas cylinder, known as a "standard leak." Many of these standard leaks have been calibrated in a 6 year old program at NIST. The program began with NIST's involvement in providing leak calibration services at Three Mile Island, where scientists assisted in an investigation of potential leakage from railroad cars carrying waste materials. NIST scientists describe the leak calibration service in a new technical report, NIST Measurement Services: NIST Leak Calibration Service (Special Publication 250-38). Available from the National Technical Information Service, Springfield, VA 22161, 1-800-336-4700. Order by PB 92-149772; for \$19 prepaid.

U.S., ITALY AGREE ON GAS PRESSURE STANDARD

NIST and the Istituto di Metrologia "G. Colonnetti" of the Consiglio Nazionale delle Ricerche, signed an agreement on May 8, 1992, recognizing the equivalency of their national standards for pressure in gas and liquid media as defined by the International System of Units (SI). Based on interlaboratory comparisons, the new agreement marks the eighth equivalency recognition between NIST and Italian national standards laboratories. NIST and

the Istituto di Metrologia also extended an agreement for their temperature scales to cover the range of 13.8 to 1235 K. They have one for length. Also on May 8, NIST and the Istituto Elettrotecnico Nazionale "Galileo Ferraris" (IEN), renewed recognition of their national standards for electrical resistance. NIST and IEN recognize the equivalency of their national standards for luminous intensity, voltage, electrical capacitance, and time. The U.S. and Italy are signatories of the Convention of the Meter and determine their basic units of measurements in accordance with definitions for SI units adopted by the General Conference of Weights and Measures.

GOVERNMENT INVENTIONS NOW AVAILABLE FOR LICENSING

NIST recently announced that the following 10 government-owned inventions are now available for licensing:

- Device and Method for Detection of Compounds Which Intercalate with Nucleic Acids;
- Multiple Memory Self-Organizing Pattern Recognition Network;
- Planar Epitaxial Films of SnO_2 ;
- Frequency Calibration Standard Using a Wide Band Phase Modulator;
- Nanocomposite Material for Magnetic Refrigeration and Superparamagnetic Systems Using the Same;
- Nitrogenated Metal Alloys Via Gas Atomization;
- Process for the Controlled Preparation of a Composite of Ultrafine Magnetic Particles Homogeneously Dispersed in a Dielectric Matrix;
- Methods of Making and Using Improved Microporous Hollow Fibers, the Improved Hollow Fibers, and Tube Bundles Constructed of the Improved Fibers;
- Diamond-Coated Laminates and Method of Producing Same; and
- Neutron-Absorbing Glass Compositions.

For technical and licensing information on these inventions, contact Bruce E. Mattson, B256 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-3084.

NIST TRAINS USDA QUALITY CONTROL OFFICIALS

The Weights and Measures Program of NIST presented a seminar on Scale Inspection and Testing for officials of the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service at the Maryland Weights and Measures Laboratory in Annapolis, MD.

The class was presented by NIST to prepare USDA personnel for implementation of new regulations on March 2. These regulations, for the first time, require scales in 12000 meat and poultry plants across the United States and abroad to conform to NIST Handbook 44—Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices. This action represents a major step towards uniformity in federal and state weights and measures requirements and will provide a higher level of economic protection for purchasers of federally regulated meat and poultry products.

NIST has supported, and continues to provide support to, USDA during the implementation of these important new regulations. To date this support has included:

- development of a field manual on package inspection for use by USDA inspectors in meat and poultry plants (based on NIST Handbook 133, Checking the Net Contents of Packaged Goods);
- surveying the ability of states to respond to requests for technical assistance and contacting states where potential problems have been identified to ensure that scale certification is provided;
- offering guidance to states to help them provide scale certification through voluntary registration programs for service agencies and technicians;
- technical guidance and assistance in responding to inquiries from industry; and
- training in package inspection and device testing procedures.

NIST STAFF DEMONSTRATES 800-FOLD IMPROVEMENT IN OPTICAL FIBER CURRENT SENSOR

NIST scientists recently achieved a new record for minimum detectable current in an optical fiber current sensor and reported the results at the 8th International Optical Fiber Sensor Conference held earlier this year. They measured the minimum

detectable current in their sensor to be 220 nA in a 1 Hz bandwidth. The previous record of 180 μ A in a 1 Hz bandwidth also was held by NIST and reported by a NIST scientist some years ago. The new NIST sensor is based on the Faraday effect in gallium-doped yttrium iron garnet (Ga:YIG), selected by the team as a result of intensive analysis of candidate materials. This material exhibits a much stronger Faraday effect than others, making it inherently possible to measure smaller currents. However, Ga:YIG is not available in large enough pieces that a single sensing element would suffice, and the design accordingly uses four small rods of the material incorporated into an optical path which encloses the conductor.

NIST DEVELOPMENTS PROVIDE IMPETUS FOR TWO START-UPS

Two small entrepreneurial companies have been formed recently as a result of NIST developments in electromagnetic compatibility and electromagnetic interference. In the first instance, a Washington, DC company was established to build standard electric field radiators of NIST design as a result of additional requests for the device from industry that NIST could not meet. Earlier, NIST had supplied several devices to a computer company that had co-sponsored the development, but considerably more were needed.

As a known source of electric field over a frequency range of 30 to 1000 MHz, the NIST standard radiator in the form of a remotely controlled radiating spherical dipole is used in conjunction with an electromagnetic test facility, such as a shielded room or open test site (ground-plane range), to determine the performance of field-measuring instrumentation used in conjunction with the facility. Companies need calibrated field measurements to be sure that tests of products such as computers reliably demonstrate compliance with emissions regulations promulgated by the Federal Communications Commission.

In the second instance, an engineer in the company that provided NIST the thin-film fabrication technology for a broadband 8 mm electric field probe subsequently formed a Denver company to produce it. This became the third U.S. commercialization of the NIST device. The probe uses the principle of a resistively tailored dipole structure to achieve an isotropic response of better than ± 0.3 dB from 100 kHz to 18 GHz and ± 0.2 dB from 1 MHz to 15 GHz for fields between 1 and 1600 V/m.

LASER-ABLATED HIGH-CRITICAL-TEMPERATURE SUPERCONDUCTOR FILMS STUDIED

Using scanning electron and scanning tunneling microscopies, a team of NIST scientists has examined the relationship between deposition parameters and morphology of laser-ablated yttrium-barium-copper oxide films (formula: $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$, where $0 \leq \delta \leq 1$). The work is motivated by the need to understand and control the topography of films of high-critical-temperature superconductors used in practical devices. Because of the extremely short coherence lengths of these superconductors, films made from them must be smooth on a nanometer scale. An additional concern is that surface roughness may increase the difficulty of growing continuous films and lead to micro short-circuits in layered structures.

NIST scientists have studied the morphologies of films deposited under a variety of conditions. They found that the deposition rate appears to determine the film-growth mechanism: in films deposited at relatively fast rates on MgO, they observe island nucleation and growth, while they found screw dislocation growth in films deposited at lower rates. The team also found that substrate temperature during deposition controls the density of the islands that nucleate. More islands nucleate at lower temperatures and, consequently, they are smaller in size than the islands in films grown at higher temperatures. A third finding is that the partial pressure of oxygen during deposition influences the roughness of the films. Smoother films were found to develop under lower oxygen pressures, but these films have the drawback of depressed transition temperatures. The NIST team is collaborating with a group at MIT producing $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ films and a group at Stanford producing a-axis $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ films.

LONGEST RANGE SCANNING TUNNELING MICROSCOPE DEVELOPED

NIST scientists have developed a scanning tunneling microscope (STM) for profiling surfaces with a wide lateral dynamic range. It can zoom from a field of view of $600\text{ }\mu\text{m}$ to a resolution limit of about 1 nm . Therefore, the overall lateral dynamic range is $600000:1$. The $600\text{ }\mu\text{m}$ field of view is a world record for long-range scanning with STMs. The instrument combines a commercial STM probe, which has atomic resolution, with a precise piezoelectric motion system for achieving the wide field of view. The instrument has two scanning stages to achieve the lateral dynamic range, the

piezoelectric stack scanner in the base for the long-range mode and the STM tube scanner in the sensor head for the high-resolution mode. The lateral resolution of the system in this mode is vibration limited and is approximately 1 nm . The system operates in air and will soon be enhanced with an atomic force sensor so that insulating surfaces can be inspected as well as electrical conductors. The scientists developed the long-range STM for high-resolution profiling of optical surfaces. It also will be used to test the surface finish of x-ray optics. An article on the long-range STM was published in the April 1992 issue of *Review of Scientific Instruments*.

WORKSHOP ON SUPERCRITICAL FLUID EXTRACTION HELD AT NIST

Supercritical fluid extraction (SFE) is a promising new technology for the rapid, automatable preparation of samples for analytical measurement. To evaluate the state of the art for this new technique, a 1 day workshop was held recently at NIST. The 50 workshop attendees included experts from academia, instrument companies, private industrial user labs, environmental contract labs, EPA, and NIST. The meeting focused on ways of using SFE to improve measurements associated with the environmental problem of leaking fuel storage and delivery tanks.

In the months prior to the meeting, NIST provided four unknown soil-type samples, as well as instrument calibration solutions, to potential workshop attendees who had agreed to participate in a round robin. Although no SFE conditions were specified for this round robin, a consensus was achieved that confirmed the optimum operating parameters arrived at as a result of NIST research.

The results of the round-robin study and extensive discussions among the participants at the workshop confirmed that SFE is a promising new technology for the rapid, routine analysis of aliphatic hydrocarbons from fuel-contaminated soil. However, more research will be needed to extend the application of SFE to more polar classes of contaminants and/or other sample types.

AUTOMATED CALIBRATION SYSTEM FOR AIR FLOW-RATE CALIBRATIONS

A NIST scientist recently completed the development of an automated data acquisition and control software package for routine air flow-rate calibrations performed at NIST. These calibrations are done using piston or bell "provers," which are accurately calibrated instruments providing direct

measurement of the quantity of displaced fluid. The algorithm, called AIR, written for an IBM compatible-PC using Turbo Pascal 6.0, is highlighted by the use of a graphical user interface, automation of most measurements, real-time data display, and a data throughput of one measurement cycle per second. The user-friendly package is expected to improve the current measurement precision of air flow-rate calibrations up to $0.05 \text{ m}^3/\text{s}$. This improvement of as much as a factor of two is due to increased data throughput and the ability of the operator to maintain steady-state conditions in the prover by monitoring measurement data in real time. Similar algorithms could be implemented in other primary-calibration facilities. Future plans call for implementation of such techniques to encompass the full range of air flow-rate calibrations at NIST (up to $1.4 \text{ m}^3/\text{s}$) and to upgrade the current water-flow automated calibration system. The beneficiaries of this development include the aerospace, petrochemical, and electronics instrumentation industries.

MAGNETIC ENGINEERING OF THIN FILMS

The recent discovery of the "giant magnetoresistance (GMR) effect" in magnetic multilayers has stimulated much interest in the antiferromagnetic coupling between magnetic layers, which is associated with the GMR effect. This effect could serve as the basis for producing new, improved non-volatile memory chips, critical to the personal computer industry. Thin films containing layers of cobalt and copper exhibit the largest GMR effect found to date. Selected samples were studied at NIST and found to be nearly polycrystalline (made up of many crystallites). This surprising result raised the question of which crystallite was most important in determining the observed physical properties. Accordingly, several different single-crystal cobalt-copper multilayers were produced and studied. These studies indicated that the (100) crystallites are responsible for the antiferromagnetic coupling. This conclusion suggests that controlling the (100) crystallite concentration in these multilayers will be a way to control the antiferromagnetic coupling and, thus, to engineer the desired values of the antiferromagnetic coupling strength for thin-film device applications.

NIST HOLDS WORKSHOP ON NVLAP IONIZING RADIATION PERSONNEL DOSIMETRY PROGRAM

On March 6, the Ionizing Radiation Division held a workshop to evaluate the impact on NIST pro-

grams of the proposed ANSI N13.11, an update on criteria for testing and performance of personnel dosimeters. The National Voluntary Laboratory Accreditation Program (NVLAP) Personnel Radiation Dosimetry Program, initiated in 1984, provides the basis for the traceability to NIST and national standards for badge dosimeters for 1.3 million U.S. workers in medical, military, and industrial radiation applications. NIST, at the top of the technical hierarchy, provides traceability for dosimetry to the processing community through Battelle Pacific Northwest Laboratories (PNL), which acts under contract to NVLAP. The workshop was attended by representatives of the U.S. Nuclear Regulatory Commission, the Department of Energy, members of the ANSI N13.11 standards-writing subcommittee, Battelle PNL, dosimetry processors, dosimetry users, and NVLAP and NIST technical experts.

GRAVITY ATTRACTS FEDERAL LAB CONSORTIUM FLC AWARD

The FLC is an organization of more than 500 U.S. government laboratories and research centers. Every year it gives up to 30 awards to recognize excellence in technology transfer. This year NIST received two of the awards. One of them was given to a NIST scientist for transferring to industry fundamental optical, electronic, and mechanical technology for the production of instruments for the ultra-precise and absolute measurement of gravity. The scientist's work resulted in not only the transfer of a particular technology but also the creation of a new U.S. industrial firm, AXIS Instruments Co. of Boulder, CO, which specializes in the design and manufacture of high-precision scientific instruments. The scientist has pioneered the development of absolute gravimeters for making fundamental measurements; six of his instruments are being used around the world to detect motions of the Earth's crust and subsurface density changes. Determining the Earth's gravity to the precision of which these instruments are capable—parts per billion—permits measurements of local height relative to the center of the Earth to better than 1 cm! The first two of the new and improved generation of gravity instruments being manufactured by AXIS for NIST will be transferred to NOAA for application in its Global Climate Change Program. They will be used to estimate the range of change of global absolute sea level, and thus to help evaluate models of global warming.

NIST PROJECT EARNS NASA COMMITTEE'S TOP PRIORITY

Almost everything known about the universe is based on the detection and analysis of electromagnetic radiation. The detection of gravitational waves would open an entirely new window on the universe, permitting searches for signals such as gravitational-wave bursts from neutron stars spiraling into supermassive black holes at vast distances. NASA formed the Ad Hoc Committee on Gravitational Physics and Astronomy in 1989 and charged it with identifying "the most important gravitational experiments [in space] that could be carried out within the next twenty years," and distilling "a (prioritized) list of generic technologies that need development." The committee's just-released report summarizes seven proposed scientific measurements and associated technologies, and rates technology development for a space-based gravitational-wave observatory first priority. The observatory could be a laser interferometer with arms $\sim 10^7$ km long orbiting the sun. In the most interesting low-frequency band, not accessible to Earth-based observatories, the goal is to measure changes in the arm lengths to a precision of about one part in 10^{20} in 1 s.

NIST scientists have been working for several years with colleagues at the University of Colorado, and more recently the Jet Propulsion Laboratory, on the conceptual design and error budget for such an observatory. It will take quite exquisite technology, some of it with possible terrestrial applications, including the development of disturbance reduction systems; low-expansion thermal insulation; spacecraft monitoring and control systems; a high-efficiency, long-lifetime laser; and an extremely precise laser-beam steering system.

PATENT ON THE "SHARPEST" STM TIP EVER

Research teams worldwide are racing to improve the potential of the scanning tunneling microscope (STM) for producing ever-smaller semiconductor devices and computer-memory elements. The goal is controlled "nanolithography" of features smaller than 10 nm, and eventually the size of individual atoms. The potential economic impact is enormous, as the structures that are now produced routinely have dimensions of hundreds of nanometers and are normally formed by optical "lithography," i.e., writing fine lines or spots with light. The STM is an attractive new tool for this because it produces a concentrated high electric field when its conducting tip is brought close to a surface, resulting in a

highly localized beam of low-energy electrons. These can stimulate molecules from the surrounding gas to etch or deposit on the surface (a.k.a., chemical vapor deposition, or CVD). The problem is that an STM probe placed close enough (≤ 0.5 nm) to the surface to generate the necessary field leaves precious little space for CVD molecules to diffuse through the gap between probe and sample. Moving the probe back to permit their passage spreads the field and electron beam over a much larger region of the sample, at great cost in resolution. A NIST scientist has just received a patent on the design of a probe end that produces a much "sharper" electron beam spot on the sample with the probe end far enough away from the surface to allow access of the CVD molecules to the desired region. This allows very precise control, essentially single-atom positioning, of reactions with the sample surface.

EXPERT SYSTEM MODULES FOR CHEMICAL PROCESS INDUSTRIES RELEASED

The NACE-NIST Corrosion Data Program, a joint activity of NIST and the National Association of Corrosion Engineers, recently released two more expert system modules in the CHEM•COR series. The CHEM•COR series is a series of personal computer programs designed to provide materials selection and usage advice to chemical process plant managers on the handling and storage of industrial corrosives, primarily hazardous chemicals. The two new modules on hydrogen chloride and chlorine combine with the previously released modules on concentrated sulfuric acid, acetic acid, and formic acid to make up the CHEM•COR series. The NACE-NIST Corrosion Data Program, with the sponsorship of the Materials Technology Institute of the Chemical Process Industries, plans 11 modules for this series.

NIST EXPANDS MICROELECTRONICS PACKAGING EFFORTS

In 1992, NIST expanded its efforts in the area of microelectronics packaging, the structures that connect modern microchips to and protect them from the outside world. Several recent studies have identified the packaging as the component most apt to limit the performance of future microelectronic systems. These new efforts expand upon packaging related work of long standing at NIST on wire bonding and thermal control by NIST scientists.

The expanded NIST efforts primarily concentrate on development or refinement of metrology of the properties of the materials in packaging, preferably in situ and at the micrometer scale, for use in research, design, manufacturing, product quality control, and failure analysis. The efforts are in partial response to needs, desires, and opportunities identified in a NIST workshop in May 1990. NIST efforts include: exploring various approaches such as fluorescence for determining the degree of cure of polymers; attempting to develop a new understanding of the material parameters affecting solderability, i.e., the ability to attach components via solder; developing techniques and procedures for measuring the separate strengths of adherends; exploring the possibility of actually embedding thin film thermocouples in the bodies of the packaging to make direct measurements of the internal temperatures without having to rely on predicted values.

ANIMATION PROGRAM FOR PROCESS SIMULATION

A NIST scientist has developed an animation program that displays interactively the results of his process simulation programs for polymer composite fabrication. The animation program shows the mold filling patterns during liquid molding and displays the resulting pressure distributions. The information is used to optimize mold design and processing parameters. For example, the location of resin injection ports can be changed to ensure that the flow does not prematurely close off regions, thus causing voids, or that flow fronts do not merge to create weak regions in critical places.

The first application of this program was the analysis of simulation results for mold filling of a demonstration part being made by the Automotive Composites Consortium (ACC). The ACC was formed to conduct pre-competitive research promoting the use of polymer composites in structural automotive applications. NIST is cooperating with the ACC by conducting process simulation studies for their demonstration part. In early March, the NIST scientist toured all three ACC members' plants to demonstrate the results of the simulation using the animation program. Representatives of the ACC found the simulations extremely useful and described the animation as a major advance over the alternative methods to study simulation results.

FIRST STATION FOR COLD NEUTRON INELASTIC SCATTERING OPERATIONAL AT NIST

The medium resolution time-of-flight spectrometer, the first of a number of experimental stations at NIST dedicated to inelastic neutron scattering research on materials, became operational in February. This highly flexible instrument, which contains over 100 neutron detectors at 10°-120° scattering angles and a focusing monochromator, allows the investigation of atomic and molecular motions and excitations over a wide range of time and energy in systems as diverse as magnetic materials, catalysts and microporous materials, fullerenes, polymers, and biological molecules. Test experiments already have been carried out studying hardening processes in cements, dynamics of small organic molecules bound in zeolites, and anomalous local diffusion of hydrogen in rare earth metals. This time-of-flight spectrometer, along with five other inelastic scattering stations under development at NIST, will provide U.S. researchers with internationally competitive facilities for the study of low-energy excitations and slow dynamic processes in condensed matter, which are often a key to the properties of chemical, biological, and high-technology materials.

NIST SQL TEST SUITE, VERSION 3.0, RELEASED

On Jan. 2, NIST released NIST SQL Test Suite, Version 3.0, to test conformance to Federal Information Processing Standard (FIPS) 127-1, Database Language SQL. Version 3.0 contains new test cases and includes additional test suites for Embedded Ada and Module Language Ada. The new test cases also are included in the existing embedded and module language test suite types (C, COBOL, FORTRAN, and Pascal) as well as the Interactive SQL test suite.

Use of Version 3.0 of the NIST SQL Test Suite will be required for validation of products after July 1. Certificates will be issued after Jan. 1, 1993, for conforming SQL implementations without deficiencies. Tested implementations will be listed in the Validated Products List, which NIST publishes quarterly as an NISTIR. Government agencies can use this information to confirm that SQL implementations conform to FIPS 127-1.

**PROFESSIONAL/TRADE ORGANIZATION
LABORATORY ACCREDITATION/
DESIGNATION PROGRAMS**

NIST has published a guide to U.S. private-sector laboratory accreditation/designation programs. NIST SP 831, Directory of Professional/Trade Organization Laboratory Accreditation/Designation Programs, provides information on 48 laboratory accreditation and similar programs operated by U.S. private-sector professional and trade organizations. These programs encompass assessments of laboratory capability, designating those entities that are judged to be competent to conduct specific tests or types of testing. Entries in this directory are based primarily on information provided by the organization and reflect the organization's view of its activities. Companion documents in this area are NIST SP 808, Directory of Federal Government Laboratory Accreditation/Designation Programs, and NISTIR 4576, Laboratory Accreditation in the United States, which provide information on similar programs operated at the federal, state, and local government levels and an introductory explanation of the subject of laboratory accreditation.

**NIST HOSTS AND SPONSORS 5TH NATIONAL
CONSORTIUM FOR SPECIALIZED
SECONDARY SCHOOLS OF MATHEMATICS,
SCIENCE, AND TECHNOLOGY**

On March 19-21, NIST was the site for the 5th Annual Conference of the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology. Sponsored by NIST and the Montgomery County, MD, Science, Mathematics, and Computer Science Program at Blair High School, the conference attracted approximately 200 teachers from specialized schools around the United States. The meeting began with pre-conference hands-on workshops for the teachers. Five of the workshops were held at NIST: Techniques in Computational Chemistry, Physics, Technology and Superconductors, Scanning Tunneling Microscope Training, and Making Good Use of Networks. Conference sessions were held March 20-21 on such topics as Making Connections between Disciplines; Nontraditional Evaluation Techniques; Product Design Engineering; Group Learning Projects; Telelearning; Gifted and Talented Underachievers; Cooperative Learning in Mathematics; Successful Integration of English, Biology and Technology; and Can Ethics in Science Be Taught? NIST Director John Lyons gave the opening remarks to the conference.

The consortium was formed in April 1988 to meet the needs of educators and students in the growing number of specialized high schools. Its goal is to foster, support, and advance the efforts of those specialized schools whose primary purpose is to attract and prepare students academically for leadership in mathematics, science, and technology.

**UPDATE OF THE NIST/EPA/NIH MASS
SPECTRAL DATABASE COMPLETED**

The NIST Mass Spectrometry Data Center has announced the May 1 release of a major update of the large Mass Spectral Database. The name of this improved database, the NIST/EPA/NIH Mass Spectral Database, emphasizes the inclusion of hundreds of new original spectra determined specifically for the database at NIH. Thousands of copies of this database are used in the data systems of commercial mass spectrometers and in a PC version developed by a NIST scientist.

The update incorporates 8500 new spectra, bringing the total number of compounds represented in the collection to 62500. Many of the new spectra have been acquired by deliberately targeting compounds that are relevant to real-life analyses and acquiring spectra of those compounds through directed determinations or acquisition of special collections.

For the first time, the database is also available in an expanded version, which includes 12500 critically evaluated replicate spectra. Given the known variability of mass spectra, providing replicate spectra can increase the probability of identifying unknown spectra during a library search. The expanded collection has a total of 75000 spectra.

Since the last update in 1990, a large fraction of the spectra in the database have been evaluated manually in an effort to correct or eliminate all poor quality spectra.

The new release of the PC version also includes several new features, including new searching/matching schemes for identifying spectra of unknown chemical compounds.

**UPDATE OF CHEMICAL KINETICS DATABASE
RELEASED**

Version 4.0 of the personal computer Chemical Kinetics Database was released for distribution to the public on April 9. The database, produced and maintained by NIST now includes data on 6900 chemical reactions, with more than 20000 individual data entries. This database is an important tool for modeling combustion systems or chemical

processes occurring in the atmosphere. The data in this database are necessary, for example, in predicting the atmospheric lifetimes of chemicals that may impact on the depletion of the Earth's ozone layer.

This software was designed by a NIST scientist and includes an option that allows users to graphically display plots of rate constants as a function of temperature. These graphs of data from different sources are useful for identifying discrepancies in experimental determinations. The new release includes a major new feature that allows the user to search the database to locate all reactions which result in the formation of a particular chemical product.

NEW ITS-90 BASED DATA FOR THERMOCOUPLES

An international collaborative effort involving national laboratories from eight countries (United States, United Kingdom, The Netherlands, Russia, Korea, Japan, Italy, and China) has produced new data on the electromotive force (emf) of type S thermocouples as a function of temperature on the International Temperature Scale of 1990 (ITS-90). These data were used in deriving a new reference function from -50 to 1768.1 °C (the melting-point temperature of platinum). Also, they were used to compute the differences in temperatures on the ITS-90 and the International Practical Temperature Scale of 1968 (IPTS-68) for the range 630 to 1064 °C. The new estimate of the temperature differences between the scales differs from previously published values by as much as 0.3 at 760 °C. These differences, however, do not in any way affect the definition of the ITS-90.

In addition to measurements on type S thermocouples, NIST and NPL (UK) obtained data on type R and type B thermocouples. NIST scientists made measurements, consulted on the design of the NIST experiment, and analyzed the data of the eight laboratories. Results of these experiments were presented at the 7th International Symposium on Temperature held in Toronto, Canada, April 28-May 1. The new reference function for the type S thermocouples and the new estimate of the differences between temperatures on the ITS-90 and the IPTS-68 will allow reference functions and tables for all ISA letter-designated thermocouples to be incorporated into voluntary standards (e.g., ASTM, ISA, and IEC) for science and industry.

COUNCIL ON IONIZING RADIATION MEASUREMENTS AND STANDARDS (CIRMS) IS ESTABLISHED

Following an organizational meeting at NIST in 1991, and the election of officers early this year, the organizing committee and officers met at NIST on March 31, to establish the Council on Ionizing Radiation Measurements and Standards (CIRMS). The organization represents tens of thousands of users of ionizing radiation engaged in industrial radiation processing, radiation therapy and diagnostics, and radiation protection and control. CIRMS will provide a forum for discussing national ionizing radiation measurement and standards problems, defining and prioritizing needed work in ionizing radiation measurements and standards, disseminating information on written standards, and organizing workshops to advance ionizing radiation technology.

INITIAL OBSERVATIONS OF IML-1 TRIGLYCINE SULFATE CRYSTAL

The first detailed examinations of the triglycine sulfate crystal grown on International Microgravity Laboratory-1, the February space shuttle flight, have now taken place. Diffraction imaging has been carried out on the high-resolution beam line at the National Synchrotron Light Source at Brookhaven National Laboratory.

Initial imaging determined the regularity of the space-grown crystal before it was cut into pieces for infrared detector fabrication and other analysis, procedures that prior work had shown might affect the crystal regularity. Subsequent images of the cut edge of the crystal were then taken to provide information on the extent and nature of the space growth and its relation to the ground-grown seed.

Initial analysis of video data collected indicates that the local acceptance angle for this crystal for highly collimated, monochromatic $8\text{-}10$ keV x rays is $1\text{-}2$ arc seconds. This critical measure of crystal regularity is substantially better than that for the best silicon crystals, which are among the most regular crystals known.

NIST ESTABLISHES MEMORANDUM OF UNDERSTANDING (MOU) WITH THE COMMUNICATIONS SECURITY ESTABLISHMENT OF CANADA

In March 1992, NIST and the Canadian Communications Security Establishment established an MOU to pursue technical cooperation in information

security (INFOSEC). The MOU provides a framework for the two governments to facilitate the coordination and development of INFOSEC standards and criteria for the protection of sensitive unclassified data. It also establishes mutual recognition of validation testing and product endorsements performed by either government to ensure compliance with mutually agreed standards and criteria. Forms of cooperation may consist of exchanges of technical information, exchange visits, and other forms of collaborative activities.

NEW PUBLICATION DESCRIBES REFERENCE MODEL (RM) FOR SOFTWARE ENGINEERING ENVIRONMENT (SEE) FRAMEWORKS

Reference Model for Frameworks of Software Engineering Environments (NIST SP 500-201), characterizes an SEE frameworks RM as a conceptual basis for describing and comparing existing SEEs and their components. An SEE deals with information about the software under development, such as specifications and design data, and project resources, such as costs and computer resources. The document was prepared jointly by NIST and the European Computer Manufacturers Association.

Standard Reference Materials

STANDARD REFERENCE MATERIALS 2534 AND 2535—ELLIPSOMETRIC PARAMETERS, Δ AND Ψ , AND DERIVED THICKNESSES AND REFRACTIVE INDEX FOR A SILICON DIOXIDE LAYER ON SILICON

NIST announces the availability of Standard Reference Materials (SRMs) 2534 (25 nm SiO₂) and 2535 (12 nm SiO₂), certified for Δ and Ψ at the vacuum wavelength of $\lambda = 633$ nm using the NIST high-accuracy ellipsometer. They are intended primarily to evaluate the accuracy of ellipsometers but also may be used as an aid in the calibration of other optical thickness-monitoring instruments.

Each SRM unit, consisting of a 77 mm diameter silicon wafer on which a uniform silicon dioxide layer has been grown, is individually certified and bears an identifying serial number. SRMs 2534 and 2535 are the latest additions to the ellipsometric standard series composed of SRMs 2531-2535.

STANDARD REFERENCE MATERIAL 473—OPTICAL MICROSCOPE LINEWIDTH MEASUREMENT STANDARD

NIST announces the availability of Standard Reference Material (SRM) 473, Optical Microscope Linewidth Measurement Standard. SRM 473 is intended for use in measuring linewidths for antireflecting-chromium integrated-circuit photo-masks. It consists of patterns of clear and opaque lines with nominal dimensions ranging from 0.5 to 30.0 μm and with line-spacing (pitch) patterns ranging from 2 to 70 μm . These patterns are on a nominal 127 \times 127 \times 2.3 mm quartz substrate. Certified values are given for the clear and opaque linewidths and the center-to-center spacings for one of the eight repeated patterns on the SRM. Each SRM 473 unit is individually certified and bears an identifying serial number.

STANDARD REFERENCE MATERIAL 968a—FAT-SOLUBLE VITAMINS IN HUMAN SERUM

NIST announces the availability of the renewal issue of Fat-Soluble Vitamins in Human Serum Standard Reference Material (SRM) 968a. This SRM is intended for use in validating methods for determining retinol, α -tocopherol, and total β -carotene in human serum and plasma. It also can be used for assigning values to in-house control materials. A unit of SRM 968a consists of six vials, two at each of three concentration levels, of lyophilized human serum. Each vial is to be reconstituted with 1.00 mL of HPLC-quality water.

In addition to certified values for retinol, γ -tocopherol and total (trans plus cis isomer) β -carotene, information values are provided for cholesterol, α -tocopherol, all trans β -carotene, α -carotene, β -cryptoxanthin, lutein, lycopene, and zeaxanthin.

Standard Reference Data

1992 SRD PRODUCTS CATALOG AVAILABLE

The NIST Standard Reference Data Products Catalog 1992, Reliable Evaluated Data for Global Problems (NIST Special Publication 782) provides scientists and engineers with the latest information on more than 65 evaluated data publications and computerized databases available from the NIST Standard Reference Data Program (SRDP) and other sources. For more than 28 years, critically evaluated data have been used to improve design efficiency of chemical processes, identify potential toxic substances in the environment, improve materials durability, and calculate performance of chemical reactors. Data compilations are available in the following areas: analytical chemistry, atomic physics, biotechnology, chemical kinetics, materials properties, molecular structure and spectroscopy, thermodynamics and thermochemistry, thermo-physical properties of fluids, as well as special databases of binary images and structured forms. To obtain a copy of SP 782, send a self-addressed mailing label to SRDP, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.

EIGHT REFRIGERANTS ADDED TO REFPROP DATABASE

A widely used personal computer database for evaluating the performance of alternate refrigerants and refrigerant mixtures now has eight new entries. The Thermodynamic Properties of Refrigerants and Refrigerant Mixtures Database (REFPROP) is an important research tool for refrigeration engineers, chemical and equipment manufacturers, and others looking to replace chlorofluorocarbon and hydrochlorofluorocarbon materials with environmentally acceptable fluids. Version 3.0 of REFPROP can produce tables of the thermodynamic and transport properties of 26 pure refrigerants and refrigerant mixtures with as many as five components. Version 3.0 of REFPROP is available for \$390; owners of a previous version may upgrade for \$100. To order NIST Standard Reference Database 23, REFPROP, contact the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416.

NEW GAS PHASE INFRARED DATABASE AVAILABLE FOR PCs

The infrared absorption spectra of more than 5,300 chemical compounds are in the new NIST/EPA Gas Phase Infrared Database. The database will be particularly helpful for analytical chemists and environmental scientists who employ infrared spectroscopy to identify unknown substances. It is a collection of gas-phase Fourier transform infrared (FT-IR) absorption spectra compiled by NIST in collaboration with the Environmental Protection Agency (EPA). The database was assembled from an archive of 3300 spectra acquired by EPA and approximately 3000 spectra measured at NIST. It has software very similar to the widely used NIST/EPA/NIH Mass Spectral Database. The two databases, mass spectra (MS) and infrared spectra (IR), can potentially be combined for use in so-called "hyphenated" MS-IR instruments. The NIST/EPA Gas Phase Infrared Database, Version 1.0, is available for \$415. It requires MS DOS 2.1 or later, 640K memory, and a color monitor. The database can be ordered from the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416.

NIST BINARY IMAGES OF HANDWRITTEN SEGMENTED CHARACTERS

NIST Special Database 3 is now available from the Standard Reference Data Program. A valuable tool for training recognition systems on a large statistical sample of hand-printed characters, the database consists of over 313000 isolated character images. Of these images, 223125 are digits; 44951 are upper-case; and 45313 are lower-case character images. Each character image has been centered in a separate 128 by 128 pixel region and has been assigned a classification which has been manually corrected so that the error rate of the segmentation and assigned classification is less than 0.1 percent. The database comes in a CD-ROM format and includes image format documentation and example software.